

CLAIMS

What is claimed is:

- 1 1. A method for constructing a soft device, the method comprising:
2 implementing a driver of the soft device in a virtual machine monitor;
3 and
4 making the soft device available for use by one or more virtual
5 machines coupled to the virtual machine monitor.
- 1 2. The method of claim 1 wherein the one or more virtual machines run
2 arbitrary operating systems for which no corresponding soft device drivers
3 exist on the market.
4
- 1 3. The method of claim 1 wherein making the soft device available for use
2 by one or more virtual machines further comprises:
3 exporting an emulation of a fixed function hardware device to said any
4 of the one or more virtual machines.
- 1 4. The method of claim 3 wherein exporting the emulation of the fixed
2 function hardware device comprises:
3 performing computations requested by said any of the one or more
4 virtual machines without notifying a residual fixed function device.

1 5. The method of claim 3 wherein exporting the emulation of the fixed
2 function hardware device comprises:
3 transferring an operation requested by said any of the one or more
4 virtual machines to a residual fixed function device; and
5 the residual fixed function device performing the operation requested
6 by said any of the one or more virtual machines.

1 6. The method of claim 3 wherein exporting the emulation of the fixed
2 function hardware device comprises:
3 performing a portion of computations requested by said any of the one
4 or more virtual machines to a residual fixed function device; and
5 performing a set of operations on hardware registers of a residual fixed
6 function device to complete a task requested by said any of the one or more
7 virtual machines.

1 7. The method of claim 3 wherein exporting the emulation of the fixed
2 function hardware device comprises:
3 manipulating data stored in memory to effect zero or more
4 transformations; and
5 transferring data to or from a residual hardware device using a direct
6 memory access (DMA) technique.

1 8. A system comprising:
2 a hardware platform including a hardware component of a soft device;

3 a virtual machine monitor, coupled to the hardware platform, the
4 virtual machine monitor including a driver of the soft device; and
5 one or more virtual machines, coupled to the virtual machine monitor,
6 the one or more virtual machines utilizing the soft device when needed.

1 9. The system method of claim 8 wherein the one or more virtual
2 machines run arbitrary operating systems for which no soft device drivers
3 exist on the market.

1 10. The system of claim 8 wherein the driver of the soft device is to export
2 an emulation of a fixed function hardware device to said any of the one or
3 more virtual machines.

1 11. A method for constructing a soft device, the method comprising:
2 implementing a software component of the soft device in a first virtual
3 machine; and
4 making the soft device available for use by a second virtual machine.

1 12. The method of claim 11 wherein the second virtual machine runs an
2 arbitrary operating system for which no corresponding soft device drivers
3 exist on the market.

1 13. The method of claim 11 wherein making the soft device available for
2 use by the second virtual machine further comprises:

3 presenting the first virtual machine to the second virtual machine as an
4 external device; and
5 emulating communication between the first virtual machine and the
6 second virtual machine.

1 14. The method of claim 13 wherein emulating communication further
2 comprises:

3 providing a virtualized serial communications link;

4 providing a virtualized serial communications port to each of the first
5 virtual machine and the second virtual machine;

6 linking the virtualized serial communications port provided to the first
7 virtual machine to the software component of the soft device using reflection
8 software;

9 trapping each access by one of the first virtual machine and the second
10 virtual machine to the virtualized serial communication port; and

11 reflecting said each access to the other of the first virtual machine and
12 the second virtual machine via the virtualized serial communications link.

1 15. The method of claim 13 wherein emulating communication further
2 comprises:

3 providing a virtualized universal serial bus (USB) to USB bridge
4 device;

5 providing a virtualized USB host controller to each of the first virtual
6 machine and the second virtual machine;

7 linking the virtualized USB host controller provided to the first virtual
8 machine to the software component of the soft device using reflection
9 software;

10 trapping each access by one of the first virtual machine and the second
11 virtual machine to the virtualized USB host controller; and

12 reflecting said each access to the other of the first virtual machine and
13 the second virtual machine via the virtualized USB to USB bridge device.

1 16. The method of claim 11 wherein making the soft device available for
2 use by the second virtual machine further comprises:

3 presenting the first virtual machine to the second virtual machine as an
4 internal device; and

5 emulating communication between the first virtual machine and the
6 second virtual machine.

1 17. The method of claim 16 wherein emulating communication further
2 comprises:

3 providing a virtualized peripheral component interconnect (PCI) bus;

4 linking the virtualized PCI bus to the software component of the soft
5 device using reflection software;

6 trapping each access by one of the first virtual machine and the second
7 virtual machine to the virtualized PCI bus; and

8 reflecting said each access to the other of the first virtual machine and
9 the second virtual machine.

1 18. The method of claim 11 wherein making the soft device available for
2 use by the second virtual machine further comprises:
3 emulating a network communication between the first virtual machine
4 and the second virtual machine by providing a virtual network interface card
5 (NIC) to each of the first virtual machine and the second virtual machine.

1 19. The method of claim 11 wherein making the soft device available for
2 use by the second virtual machine further comprises:
3 presenting the first virtual machine to the second virtual machine as a
4 hardware device; and
5 emulating communication between the first virtual machine and the
6 second virtual machine.

1 20. The method of claim 19 wherein emulating communication further
2 comprises:
3 providing a virtualized peripheral component interconnect (PCI) bus;
4 trapping each access by one of the first virtual machine and the second
5 virtual machine to the virtualized PCI bus; and
6 reflecting said each access to the other of the first virtual machine and
7 the second virtual machine via the virtualized PCI bus.

1 21. The method of claim 19 wherein emulating communication further
2 comprises:
3 providing a virtualized universal serial bus (USB) connection;

4 providing a virtualized USB bus interface to the first virtual machine;
5 providing a virtualized USB host controller to the second virtual
6 machine;
7 trapping each access by one of the first virtual machine and the second
8 virtual machine to the virtualized USB bus; and
9 reflecting said each access to the other of the first virtual machine and
10 the second virtual machine via the virtualized USB connection.

1 22. The method of claim 19 wherein the hardware device is any one of a
2 PCI card, an external USB device, an internal USB device, and any other
3 standard personal computer peripheral device.

1 23. The method of claim 19 wherein presenting the first virtual machine to
2 the second virtual machine as a hardware device further comprises:
3 configuring the first virtual machine to match the hardware device.

1 24. The method of claim 23 wherein the software component of the soft
2 device comprises at least a portion of software of a fixed function device.

1 25. The method of claim 24 further comprising:
2 varying the portion of software that is used as the software component
3 depending on how closely the first virtual machine matches the hardware
4 device.

1 26. A method for constructing a soft device, the method comprising:
2 implementing software components of the soft device in a plurality of
3 dedicated virtual machines; and
4 making the soft device available for use by a main virtual machine.

1 27. The method of claim 26 wherein the main virtual machine runs an
2 arbitrary operating system for which no corresponding soft device drivers
3 exist on the market.

1 28. The method of claim 26 wherein making the soft device available for
2 use by the main virtual machine further comprises:
3 presenting the plurality of dedicated virtual machines to the main
4 virtual machine as a hardware device; and
5 emulating communication between the plurality of dedicated virtual
6 machines and between each of the plurality of dedicated virtual machines and
7 the main virtual machine.

1 29. The method of claim 28 wherein emulating communication further
2 comprises:
3 providing a virtualized communication means to the plurality of
4 dedicated virtual machines and to the main virtual machine.

1 30. The method of claim 29 wherein the virtualized communication means
2 is any one of a virtualized serial communications link, a virtualized universal

3 serial bus (USB) to USB bridge device, a virtualized peripheral component
4 interconnect (PCI) bus, a virtual network interface card, and a virtualized USB
5 connection.

1 31. A system comprising:
2 a hardware platform including a hardware component of a soft device;
3 a virtual machine monitor, coupled to the hardware platform; and
4 a plurality of virtual machines, coupled to the virtual machine monitor,
5 the plurality of virtual machines including one or more dedicated virtual
6 machines, in which one or more software components of a soft device are
7 implemented, and remaining one or more virtual machines utilizing the soft
8 device when needed.

1 32. The system of claim 31 wherein any of the remaining virtual machines
2 runs an arbitrary operating system for which no corresponding soft device
3 drivers exist on the market.

1 33. The system of claim 31 wherein the VMM is to make the soft device
2 available by presenting the dedicated virtual machines to the remaining
3 virtual machines as one or more external devices and emulating
4 communication between the plurality of virtual machines.

1 34. The system of claim 31 wherein the VMM is to make the soft device
2 available by presenting the dedicated virtual machines to the remaining

- 3 virtual machines as one or more internal devices and emulating
- 4 communication between the plurality of virtual machines.

1 35. The system of claim 31 wherein the VMM is to make the soft device
2 available by emulating a network communication between the plurality of
3 virtual machines by providing a virtual network interface card (NIC) to each
4 of the plurality of virtual machines.

1 36. The system of claim 31 wherein the VMM is to make the soft device
2 available by presenting the dedicated virtual machines to the remaining
3 virtual machines as a hardware device and emulating communication
4 between the plurality of virtual machines.

1 37. The system of claim 36 wherein the hardware device is any one of a
2 PCI card, an external USB device, an internal USB device, and any oother
3 standard personal computer peripheral device.

1 38. The system of claim 36 wherein the VMM is to emulate communication
2 by providing a virtualized communication means to the plurality of virtual
3 machines.

1 39. The system of claim 38 wherein the virtualized communication means
2 is any one of a virtualized serial communications link, a virtualized universal
3 serial bus (USB) to USB bridge device, a virtualized peripheral component

4 interconnect (PCI) bus, a virtual network interface card, and a virtualized USB
5 connection.

1 40. A computer readable medium that provides instructions, which when
2 executed on a processor, cause said processor to perform operations
3 comprising:

4 implementing a driver of the soft device in a virtual machine monitor;

5 and

6 making the soft device available for use by one or more virtual

7 machines coupled to the virtual machine monitor.

1 41. The computer readable medium of claim 40 wherein the one or more
2 virtual machines run arbitrary operating systems for which no corresponding
3 soft device drivers exist on the market.

1 42. A computer readable medium that provides instructions, which when
2 executed on a processor, cause said processor to perform operations
3 comprising:

4 implementing a software component of the soft device in a first virtual
5 machine; and

6 making the soft device available for use by a second virtual machine.

1 43. The computer readable medium of claim 42 wherein the second virtual
2 machine runs an arbitrary operating system for which no corresponding soft

3 device drivers exist on the market.

1 44. A computer readable medium that provides instructions, which when
2 executed on a processor, cause said processor to perform operations
3 comprising:

4 implementing software components of the soft device in a plurality of
5 dedicated virtual machines; and

6 making the soft device available for use by a main virtual machine.

1 45. The computer readable medium of claim 44 wherein the main virtual
2 machine runs an arbitrary operating system for which no corresponding soft
3 device drivers exist on the market.